

Description

REFLECTOR ANTENNA RADOME WITH BACKLOBE SUPPRESSOR RING AND METHOD OF MANUFACTURING

BACKGROUND OF INVENTION

[0001] Field of the Invention

[0002] This invention relates to reflector antenna radomes. More particularly, the invention relates to a reflector antenna radome with a backlobe suppression ring around the radome periphery.

[0003] Description of Related Art

[0004] The front to back (F/B) ratio of a reflector antenna indicates the proportion of the maximum antenna signal that is radiated in any backward directions relative to the main beam, across the operating band. Rearward signal patterns, also known as backlobes, are generated by edge diffraction occurring at the periphery of the reflector dish. Where significant backlobes are generated, signal inter-

ference with other RF systems may occur and overall antenna efficiency is reduced. Local and international standards groups have defined acceptable F/B ratios for various RF operating frequency bands.

[0005] Prior reflector antennas have used a range of different solutions to maintain an acceptable F/B ratio. For example, conical RF shields which extend forward of the reflector may be applied. However, shield structures increase the overall size, wind load and thereby structural requirements of the antenna, increasing overall antenna and antenna support structure costs. Edge profiling, chokes and or reflector edge notching/serration patterns have been formed in and or applied to the reflector dish periphery. However, these structures, in addition to significantly increasing the manufacturing costs of the resulting antenna, increase antenna wind loading and are typically optimized for a specific frequency band which limits the available market segments for each specific reflector dish design, decreasing manufacturing efficiencies.

[0006] F/B ratio is especially significant in modern shield less deep dish reflectors. Deep dish reflectors, by having a low focal length to reflector dish diameter ratio, may be formed with increased aperture efficiency and low side

lobes without requiring peripheral shielding. However, to achieve these radiation patterns, the edges of the deep dish reflectors are designed to have higher signal illumination levels relative to shallow dish designs, increasing reflector edge diffraction and thereby generating significant backlobes.

[0007] Competition within the reflector antenna industry has focused attention on RF signal pattern optimization, structural integrity, as well as materials and manufacturing operations costs. Also, increased manufacturing efficiencies, via standardized reflector antenna components usable in configurations adaptable for multiple frequency bands is a growing consideration in the reflector antenna market.

[0008] Therefore, it is an object of the invention to provide an apparatus that overcomes deficiencies in the prior art.

BRIEF DESCRIPTION OF DRAWINGS

[0009] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

[0010] Figure 1 is a cut-away side view of a reflector antenna

with a radome according to one embodiment of the invention.

[0011] Figure 2 is a close-up view of area A of Figure 1.

[0012] Figure 3 is an isometric view of the radome of Figure 1, showing the front surface and side edge.

[0013] Figures 4a and 4b are charts demonstrating comparative measured signal radiation patterns, in h and e planes respectively, of a reflector antenna operating at 12.7GHz with and without a backlobe suppression ring according to the invention.

[0014] Figure 5 is a chart demonstrating comparative measured signal radiation patterns of a reflector antenna operating at 21.2GHz with and without a backlobe suppression ring according to the invention.

DETAILED DESCRIPTION

[0015] The invention is described in an exemplary embodiment applied upon a radome also having toolless quick attach/detach features further described in US utility patent application serial number 10/604,756 "Dual Radius Twist Lock Radome and Reflector Antenna for Radome", by Ju-naid Syed et al, filed August 14, 2003 and hereby incorporated by reference in the entirety. The invention is de-

scribed herein with respect to a single profile radome. One skilled in the art will appreciate that the invention may also be applied, for example, to the dual radius radome configurations disclosed in the aforementioned application.

[0016] As shown in Figure 1, a typical deep dish reflector antenna 1 projects a signal from a feed 3 upon a sub reflector 5 which reflects the signal to illuminate the reflector 7. A radome 9 covers the open distal end of the reflector 7 to form an environmental seal and reduce the overall wind load of the antenna 1.

[0017] As shown in Figures 2 and 3, a conductive ring herein after identified as a backlobe suppression ring (BSR) 11, is formed around the radome 9 periphery. The BSR 11 may be formed, for example, by metalising, electroplating or over molding the edge of the radome 9. Alternatively, the BSR 11 may be formed by coupling a BSR formed of, for example, conductive rubber, metal, metallic foil, metallic tape or the like, about the radome 9 periphery. The conductive ring forming the BSR 11 need not be continuous and or interconnected around the radome circumference, for example, the conductive ring may be formed as electrically isolated segments arranged around the periphery.

[0018] As shown in greater detail in Figure 2, where metalising or the like is used about the radome 9 periphery, the BSR 11 may be cost efficiently formed surrounding the inside 13 and the outside 15 of the radome 9 periphery. Preferably, the BSR 11 is in electrical contact with the reflector 7 periphery. Thereby, electrical gaps and or slots through which RF energy may pass to diffract from the reflector 7 outer edge are avoided.

[0019] The radome 9 has an outer diameter adapted to enable coupling of the radome 9 upon the distal open end of the reflector 7. The BSR 11, formed about the outer surface of the radome periphery does not significantly increase the radome outer diameter. Therefore, the addition of the BSR 11 to the radome 9 does not significantly add to the antenna 1 wind load. Also, because the BSR 11 may be as formed as a thin metalised layer, it does not significantly increase weight and therefore the structural requirements of the antenna 1 or antenna 1 support structures.

[0020] In operation, RF signals which would otherwise edge diffract rearward at the outward facing reflector 7 edge are instead trapped by the generally radially inward facing radome 9 outer 15 surface and or inner 13 surface edge(s) of the BSR 11. Due to the inward facing edge(s) 16 pre-

sented by the BSR 11, backwards edge diffracted energy overall is significantly reduced.

[0021] Contrary to prior frequency specific serrated, notched or choke reflector edge configurations, the BSR 11 may be applied without complex or precise design of the BSR 11 geometry. A general limit of the BSR 11 inner radius is that the BSR 11 should not project inward to a point where it will significantly interfere with the forward beam pattern of the antenna 1, for example extending inward not substantially farther than an inner diameter of the reflector 7 distal end. To further minimize spill over in forward hemisphere, an absorber 17 may be applied between the radome 9 and the reflector 7. The absorber 17 may be formed from an RF absorbing material and or an RF absorbing coating applied to the radome 9 and or the reflector 7 periphery.

[0022] Measured test range data, as shown in Figures 4a and 4b obtained from 1 foot diameter deep dish reflector antennas configured for operation at 12.7 GHz demonstrates the significant backlobe reduction generated by the present invention. The axial backlobe(s), identified by the right and left edges of the e-plane and h-plane radiation patterns shown, are reduced by more than 10 dB through

the addition of the BSR 11 to the radome 9. Further, the aperture control of the antenna, outside of approximately plus or minus 80 degrees, is also significantly improved. The antenna of figures 4a and 4b has an outside 15 surface BSR 11 with a width, measured from the radome 9 periphery towards the radome 9 center, of 22 mm.

[0023] Similarly, Figure 5 shows h-plane test data from the same reflector and radome profile (different feed assembly) operating at 21.2 GHz. This antenna 1 has an outside 15 surface BSR 11 with a width of 15 mm. Because the antennas of Figures 4a, 4b and 5 are able to gain the benefit of the present invention while using the same basic reflector dish and radome profile (but different feed assemblies) there is a significant manufacturing economy.

[0024] The present invention brings to the art a radome which cost efficiently improves the F/B ratio of an antenna. The invention may be applied to new or existing antennas without significantly increasing the antenna weight and or wind load characteristics. The invention provides F/B ratio improvement independent of antenna operating frequency and does not place any additional requirements upon the design and or manufacture of the reflector 7 dish.

[0025] Table of Parts

1	reflector antenna
3	feed
5	sub reflector
7	reflector
9	radome
11	BSR
13	inside
15	outside
16	inward facing edge
17	absorber

[0026] Where in the foregoing description reference has been made to ratios, integers, components or modules having known equivalents then such equivalents are herein incorporated as if individually set forth.

[0027] While the present invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus, methods, and illustrative exam-

ples shown and described. Accordingly, departures may be made from such details without departure from the spirit or scope of applicant's general inventive concept. Further, it is to be appreciated that improvements and/or modifications may be made thereto without departing from the scope or spirit of the present invention as defined by the following claims.